

can deflect at least 6 inches horizontally forward with no contact between any part of the cargo tank motor vehicle which contains lading during transit and with any part of the rear-end protection device, or with a vertical plane passing through the outboard surface of the protection device.

(2) The dimensions of the rear-end cargo tank protection device shall conform to the following:

(i) The bottom surface of the rear-end protection device must be at least 4 inches below the lower surface of any part at the rear of the cargo tank motor vehicle which contains lading during transit and not more than 60 inches from the ground when the vehicle is empty.

(ii) The maximum width of a notch, indentation, or separation between sections of a rear-end cargo tank protection device may not exceed 24 inches. A notched, indented, or separated rear-end protection device may be used only when the piping at the rear of the cargo tank is equipped with a sacrificial device outboard of a shut-off valve.

(iii) The widest part of the motor vehicle at the rear may not extend more than 18 inches beyond the outermost ends of the device or (if separated) devices on either side of the vehicle.

(3) The structure of the rear-end protection device and its attachment to the vehicle must be designed to satisfy the conditions specified in paragraph (d)(1) of this section when subjected to an impact of the cargo tank motor vehicle at rated payload, at a deceleration of 2 "g". Such impact must be considered as being uniformly applied in the horizontal plane at an angle of 10 degrees or less to the longitudinal axis of the vehicle.

(e) *Longitudinal deceleration protection.* In order to account for stresses due to longitudinal impact in an accident, the cargo tank shell and heads must be able to withstand the load resulting from the design pressure in combination with the dynamic pressure resulting from a longitudinal deceleration of 2 "g". For this loading condition, the allowable stress value used may not exceed the ultimate strength of the material of construction using a safety factor of 1.3. Performance testing, analytical methods,

or a combination thereof, may be used to prove this capability provided the methods are accurate and verifiable. For cargo tanks with internal baffles, the decelerative force may be reduced by 0.25 "g" for each baffle assembly, but in no case may the total reduction in decelerative force exceed 1.0 "g".

[Amdt. 178-89, 54 FR 25023, June 12, 1989, as amended at 55 FR 37061, Sept. 7, 1990; Amdt. 178-105, 59 FR 55175, Nov. 3, 1994; Amdt. 178-118, 61 FR 51341, Oct. 1, 1996]

§ 178.345-9 Pumps, piping, hoses and connections.

(a) Suitable means must be provided during loading or unloading operations to ensure that pressure within a cargo tank does not exceed test pressure.

(b) Each hose, piping, stop-valve, lading retention fitting and closure must be designed for a bursting pressure of the greater of 100 psig or four times the MAWP.

(c) Each hose coupling must be designed for a bursting pressure of the greater of 120 psig or 4.8 times the MAWP of the cargo tank, and must be designed so that there will be no leakage when connected.

(d) Suitable provision must be made to allow for and prevent damage due to expansion, contraction, jarring, and vibration. Slip joints may not be used for this purpose in the lading retention system.

(e) Any heating device, when installed, must be so constructed that the breaking of its external connections will not cause leakage of the cargo tank lading.

(f) Any gauging, loading or charging device, including associated valves, must be provided with an adequate means of secure closure to prevent leakage.

(g) The attachment and construction of each loading/unloading or charging line must be of sufficient strength, or be protected by a sacrificial device, such that any load applied by loading/unloading or charging lines connected to the cargo tank cannot cause damage resulting in loss of lading from the cargo tank.

(h) Use of a nonmetallic pipe, valve or connection that is not as strong and

heat resistant as the cargo tank material is authorized only if such attachment is located outboard of the lading retention system.

[Amdt. 178-89, 54 FR 25025, June 12, 1989, as amended at 55 FR 37061, Sept. 7, 1990, Amdt. 178-89, 56 FR 27877, June 17, 1991; Amdt. 178-118, 61 FR 51341, Oct. 1, 1996]

§ 178.345-10 Pressure relief.

(a) Each cargo tank must be equipped to relieve pressure and vacuum conditions in conformance with this section and the applicable individual specification. The pressure and vacuum relief system must be designed to operate and have sufficient capacity to prevent cargo tank rupture or collapse due to over-pressurization or vacuum resulting from loading, unloading, or from heating and cooling of lading.

(b) *Type and construction of relief systems and devices.* (1) Each cargo tank must be provided with a primary pressure relief system consisting of one or more reclosing pressure relief valves. A secondary pressure relief system consisting of another pressure relief valve in parallel with the primary pressure relief system may be used to augment the total venting capacity of the cargo tank. Non-reclosing pressure relief devices are not authorized in any cargo tank except when in series with a reclosing pressure relief device. Gravity actuated reclosing valves are not authorized on any cargo tank.

(2) When provided by § 173.33(c)(1)(iii) of this subchapter, cargo tanks may be equipped with a normal vent. Such vents must be set to open at not less than 1 psig and must be designed to prevent loss of lading through the device in case of vehicle overturn.

(3) Each pressure relief system must be designed to withstand dynamic pressure surges in excess of the design set pressure as specified in paragraphs (b)(3) (i) and (ii) of this section. Set pressure is a function of MAWP as set forth in paragraph (d) of this section.

(i) Each pressure relief device must be able to withstand dynamic pressure surge reaching 30 psig above the design set pressure and sustained above the set pressure for at least 60 milliseconds with a total volume of liquid released not exceeding one gallon before the relief device recloses to a leak-tight con-

dition. This requirement must be met regardless of vehicle orientation. This capability must be demonstrated by testing. An acceptable test procedure is outlined in TTMA RP No. 81—"Performance of Spring Loaded Pressure Relief Valves on MC 306, MC 307, and MC 312 Tanks," May 24, 1989 edition.

(ii) After August 31, 1995, each pressure relief device must be able to withstand a dynamic pressure surge reaching 30 psig above the design set pressure and sustained above the design set pressure for at least 60 milliseconds with a total volume of liquid released not exceeding 1 L before the relief valve recloses to a leak-tight condition. This requirement must be met regardless of vehicle orientation. This capability must be demonstrated by testing. TTMA RP No. 81, cited in paragraph (b)(3)(i) of this section, is an acceptable test procedure.

(4) Each reclosing pressure relief valve must be constructed and installed in such a manner as to prevent unauthorized adjustment of the relief valve setting.

(5) No shut-off valve or other device that could prevent venting through the pressure relief system may be installed in a pressure relief system.

(6) The pressure relief system must be mounted, shielded and drainable so as to minimize the accumulation of material that could impair the operation or discharge capability of the system by freezing, corrosion or blockage.

(c) *Location of relief devices.* Each pressure relief device must communicate with the vapor space above the lading as near as practicable to the center of the vapor space. For example, on a cargo tank designed to operate in a level attitude, the device should be positioned at the horizontal and transverse center of the cargo tank; on cargo tanks sloped to the rear, the device should be located in the forward half of the cargo tank. The discharge from any device must be unrestricted. Protective devices which deflect the flow of vapor are permissible provided the required vent capacity is maintained.

(d) *Settings of pressure relief system.* The set pressure of the pressure relief